Questions Chapter 1

1. Small airways are only different from large airways in size.
   a. True
   b. False

2. As a you exhale, your small airways are certain to:
   a. Snap
   b. Crackle
   c. Pop
   d. Shrink

3. The lungs are attached to the chest wall by:
   a. Sticky pleural fluid
   b. Suction
   c. Small pores termed the pores of Kohn
   d. Luck

4. Pleural pressure, relative to atmospheric pressure is:
   a. Positive
   b. Negative
   c. The Same

5. If you become morbidly obese, your FRC becomes:
   a. Larger
   b. Smaller
   c. Stay the same

6. Because of your designer asbestos oven-mit collection, you develop pulmonary fibrosis. Your FRC will become:
   a. Larger
   b. Smaller
   c. Stay the same
   d. www.ebay.com/asbestos-ovenmitsgalore

7. In order to look cool and attract mates, you develop a smoking habit

and, consequently, severe emphysema. Your FRC is:

a. Larger
b. Smaller
c. The same
d. More attractive

8. Upon visiting a jungle village while on vacation, you are stuck with a curare dart by an angry waiter. The amount of time it'll take you to become hypoxic most depends on:

a. Your FRC
b. What you last ate
c. The weather
d. All of the above

9. Blood sitting still in the alveolar capillary continues to fill with oxygen until it reaches a saturation of 100%:

a. True
b. False

10. By raising the VQ ratio of remaining segments, you can correct for hypoxemia caused by low VQ segments:

a. True
b. False

11. By raising the VQ ratio of remaining segments, you can correct for hypercapnia caused by low VQ segments:

a. True
b. False

12. During periods of intense exercise, a blood cell traverses the alveolar capillary in less time and hypoxia worsens in:

a. Disorders that cause VQ mismatch
b. Disorders that cause diffusion limitations
c. Neither, oxygenation is independent of the speed of the red blood cell.

13. Hypoxic vasoconstriction is a strong effect that is difficult to over-

come:

a. True
b. False

14. Vasodilatory drugs can cause worsening hypoxemia by:

a. Interfering with the lung's hypoxic vasoconstriction
b. Causing hypercapnia

15. Interfering with the lung's diffusion mechanisms

a. All of the above

16. The reason CO2 is not sensitive to low VQ states is because it is more efficiently removed since it is fat soluble:

a. True
b. False

17. AutoPEEP is:

a. A new mechanical ventilation mode
b. A solution to prostate problems
c. What happens when your exhalation time exceeds the time available for exhalation

Answers Chapter 1

1. Small airways are only different from large airways in size.

Answer: b — Small airways are different from large airways in size, but also in composition. They are special because they have very few supportive structures within their walls and need surrounding tissues to stay open.

2. As a you exhale, your small airways are certain to:

Answer: d — Connective tissues in the shrinking lungs becomes laxer and the small airways lose support and shrink.

3. The lungs are attached to the chest wall by:

Answer: b — The chest wall and lungs are suctioned together (stuck together with negative pressure, a vacuum). If nothing expandable, such as air, enters the space between them, they cannot be separated since the atmospheric pressure squeezes them together.

4. Pleural pressure, compared to atmospheric pressure is:

Answer: b — Pleural pressure is negative compared to the atmospheric pressure. The chest wall and lung are trying to separate. The fluid between them does not stretch and, without gas to fill the space, a negative pressure (vacuum) forms.

5. If you become morbidly obese, your FRC becomes:

Answer: b — In morbid obesity, the heavy tissues around the chest wall and the belly press on the chest and diaphragm. This external pressure decreases FRC which is the balance between the chests tendency to spring outwards and the lung's tendency to shrink inwards.

6. Because of your designer asbestos oven-mit collection, you develop pulmonary fibrosis. Your FRC will become:

Answer: b — Pulmonary fibrosis causes scarring of the lung tissue and as tissue scars, it contracts. The contracted lung shrinks and pulls the

chest wall inwards and decreases FRC.

7. In order to look cool and attract mates, you develop a smoking habit and, consequently, severe emphysema. Your FRC is:

Answer: a — Emphysema causes air trapping and a dissolution of the lung's connective tissues both of which increase FRC.

8. Upon visiting a jungle village while on vacation, you are stuck with a curare dart by an angry waiter. The amount of time it'll take you to become hypoxic most depends on:

Answer: a — Your oxygen store is your FRC. The smaller it is, the less time you have before hypoxemia sets in.

9. Blood sitting still in the alveolar capillary continues to fill with oxygen until it reaches a saturation of 100%:

Answer: b — The blood fills with oxygen until it is in equilibrium. That equilibrium will be at a saturation determined by the partial pressure of oxygen. The saturation does not continue to increase as time goes on, it settles at equilibrium.

10. By raising the VQ ratio of remaining segments, you can correct for hypoxemia caused by low VQ segments:

Answer: b — High VQ segments can't compensate for low VQ segments. The maximum saturation of blood caps at 100%. The normoxic blood from high VQ segments can't compensate for hypoxic blood pouring into the pulmonary veins.

11. By raising the VQ ratio of remaining segments, you can correct for hypercapnia caused by low VQ segments:

Answer: a — In contrast to hypoxia, hypercapnia can be corrected with high VQ segments. See the text for more detail, but briefly, the machinery runs backwards and the drainage of the acinus increases with higher VQ ratio.

12. During periods of intense exercise, a blood cell traverses the alveo-

lar capillary in less time and hypoxia worsens in:

Answer: b — In disorders that cause a diffusion limitation, the speed at which a blood cell runs through the capillary becomes more important because the time to reach equilibrium increases. If the blood cell travels too quickly, it can exit the capillary before reaching equilibrium.

13. Hypoxic vasoconstriction is a strong effect that is difficult to overcome:

Answer: b — Pulmonary vasculature is not very muscular, hypoxic vasoconstriction is not a very strong force and can be overcome by effects such as lung positioning and medications.

14. Vasodilatory drugs can cause worsening hypoxemia by:

Answer: a — Vasodilatory drugs such as calcium channel blockers can worsen hypoxia by interfering with hypoxic vasoconstriction and thus effecting the lung's ability to protect itself from VQ mismatch.

15. The reason CO2 is not sensitive to low VQ states is because it is more efficiently removed since it is fat soluble:

Answer: b — Although CO2's fat solubility makes it easier to traverse cell membranes and makes it easier to diffuse, it is the fact that high VQ segments can compensate for low VQ segments that makes CO2 tolerant to low VQ states.

16. AutoPEEP is:

Answer: c — When the time that the patient needs to fully exhale exceeds the time available, the patient breath stacks. Breath stacking increases the gas build-up in the chest causing autoPEEP. AutoPoop on the other hand…

Questions Chapter 2

1. Hyper-perfusing a normal lung will:
   a. Generate larger quantities of well oxygenated blood.
   b. Generate hypoxemic blood.
   c. Cause diffusion in the lung to slow.
   d. None of the above.

2. Hypoxia is most commonly due to diffusion problems:
   a. True
   b. False

3. Shunting is:
   a. An extreme form of low VQ ratio.
   b. An extreme form of high VQ ratio.
   c. Is unrelated to VQ ratio.
   d. None of the above.

4. Hypoxemia in ARDS is mainly due to:
   a. Diffusion problems.
   b. Intrapulmonary shunting.
   c. VQ mismatch.
   d. b & c

5. You develop a massive pulmonary embolism. As you wait for the ambulance you think: The low oxygen saturation is due to the lack of blood flow into the occluded section of lung.
   a. a) True
   b. b) False

6. VQ mismatch does not affect your CO2:
   a. a) True
   b. b) False

7. In COPD, the low oxygen saturation is mainly because of diffusion impediments :
   a. a) True

b. b) False

8. High CO2 levels are usually due to an excessive amount of CO2 production.
   a. True
   b. False

9. Dead space is an extreme form of ventilation perfusion mismatch.
   a. True
   b. False

10. The patient is connected to the ventilator at the wye.
    a. True
    b. False

11. The ventilator circuit is called such because of an integrated circuit that controls the flows.
    a. True
    b. False

12. The ventilator measures the pressure inside the patient's lungs:
    a. Measures the pressure of the ventilator circuit.
    b. Measures the pressure inside the patients chest.
    c. Both a and b.
    d. None of the above.

13. The plateau pressure is measured at the end of expiration:
    a. a) True
    b. b) False

14. Dead space added to the patient by mechanical ventilation:
    a. a) Includes the length of the ventilator limbs.
    b. b) Begins at the wye.
    c. c) Does not include the length of the endotracheal tube.
    d. d) Becomes less important as tidal volume decreases.

15. A patient with severe kyphoscoliosis and chronic hypercapnia:
    a. Can maintain a normal minute ventilation.

b. Can easily tolerate increases in CO2 production.
c. Will tolerate increases in metabolic rate.
d. Relies on renal function to maintain a normal blood pH.

Answers Chapter 2

1. Hyper-perfusing a normal lung will:

Answer: b — A hyper-perfused lung, for example the twin of a ligated lung, will start to generate hypoxic blood since the higher perfusion will cause low VQ segments.

2. Hypoxia is most commonly due to diffusion problems:

Answer: b — False, While diffusion can cause hypoxia, the main issue is a VQ mismatch.

3. Shunting is:

Answer: a — Shunting is an extreme form of low VQ ratio where ventilation is nil.

4. Hypoxemia in ARDS is mainly due to:

Answer: d — There are probably elements of all shunting, VQ mismatch, and diffusion issues, but the main issues are shunting (which is another way of saying severe low VQ ratio).

5. You develop a massive pulmonary embolism. As you wait for the ambulance you think: The low oxygen saturation is due to the lack of blood flow into the occluded section of lung.

Answer: b — Hypoxia from a pulmonary embolism is due to the higher blood flow that is re-directed to the un-occluded lung, which causes low VQ ratios. The occluded lung becomes part of the patient's dead space.

6. VQ mismatch does not affect your CO2:

Answer: b — VQ mismatch affects CO2 as well as O2. The CO2 is less sensitive to VQ mismatch (for various reasons discussed in the text).

7. In COPD, the low oxygen saturation is mainly because of diffusion

impediments :

Answer: b — In COPD hypoxia is due to VQ mismatch. Whenever anyone asks you why someone is hypoxic, you're right 90% of the time if you say VQ mismatch.

8. High CO2 levels are usually due to an excessive amount of CO2 production.

Answer: b — The more common cause of high CO2 is hypoventilation; essentially too many low VQ segments to compensate for.

9. Dead space is an extreme form of ventilation perfusion mismatch.

Answer: a — Dead space is an extreme form of high VQ ratio. The perfusion is nil, the VQ ratio tends to infinity.

10. The patient is connected to the ventilator at the wye.

Answer: a — True. Wye oh why.

11. The ventilator circuit is called such because of an integrated circuit that controls the flows.

Answer: b — False, it's called the circuit because it provides a circuit for gas to flow to and from the ventilator.

12. The ventilator measures the pressure inside the patient's lungs:

Answer: a — The ventilator only measures the pressure in the circuit. The pressure inside the patient is unmeasured unless we perform the various breath hold maneuvers — the inspiratory pause or the expiratory pause.

13. The plateau pressure is measured at the end of expiration:

Answer: b — False. We measure the plateau pressure at the end of inspiration. The point of the plateau pressure is to check the static pressure of the chest/lung. We pause flow at the end of inspiration to remove the contribution of flow to pressure, and to allow the pressure

within the chest to equilibrate with the pressure in the circuit.

14. Dead space added to the patient by mechanical ventilation:

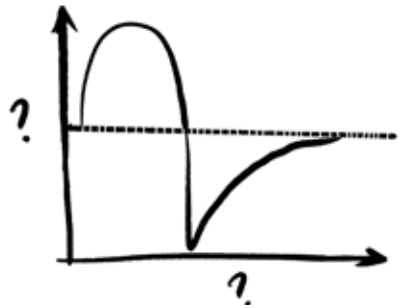
Answer: b — Dead space on mechanical ventilation includes the section of tubing from the wye to the patient. Tubing beyond the wye, on dual limb circuits, has gas flow continuously clearing CO2. Gas from the wye to the patient does not and has to be ventilated with each breath. In a single limb ventilator, there is an exhalation valve close to the patient and that is where the dead space usually begins.

15. A patient with severe kyphoscoliosis and chronic hypercapnia:

Answer: d — Patients with severe restrictive lung diseases, such as kyphoscoliosis, can become chronically hypercapnic. Renal production of bicarbonate allows them to maintain a (close to normal) pH. A disruption in the kidney's ability to generate bicarbonate (such as when they get renal failure) can throw them into concurrent respiratory failure because they can't compensate by increasing minute ventilation.

Question Chapter 3

1. What curve is this?



2. The time it takes to deliver a volume targeted breath:
   a. Depends on the I time set
   b. Depends on the flow rate set
   c. Depends on the inflow wave pattern
   d. All of the Above

3. A dual target breath is best for:
   a. DKA patients just intubated
   b. Septic shock patients
   c. Stable pneumonia patient
   d. Brain injured patient with Biot breathing

4. A mandatory breath is always triggered by the machine.
   a. True.
   b. False

5. A spontaneous breath is always triggered by the patient.
   a. True
   b. False

6. In a pressure targeted breath, if the patient's lung compliance decreases, what happens to the breath volume?
   a. Rises
   b. Drops
   c. Stays the same

7. In a volume targeted breath, if the patient's lung compliance decreases, what happens to the breath volume?

a. Rises
b. Drops
c. Stays the same

8. Continuous Mandatory Ventilation should be use for all except:

a. A just intubated, paralyzed patient.
b. A patient with apneic episodes due to a stroke.
c. A patient getting assessed for extubation.
d. A brain dead patient awaiting organ donation.

9. In Continuous Mandatory Ventilation, breath depth is always constant.

a. True
b. False

10. In Intermittent Mandatory Ventilation, the patient's spontaneous breaths are always machine triggered.

a. True
b. False

11. In Spontaneous mode, the ventilator cycles the breath when:

a. Pressure in the circuit drops
b. Breath time is up
c. The inspiratory flow rate drops
d. The patient bites down on the endotracheal tube.

12. Exhalation time depends on the mechanical breath's inspiration time.

a. True
b. False

13. The time needed for exhalation may change over the course of the patient's illness.

a. True
b. False

14. Time needed for exhalation determines how quickly a patient can be ventilated.

a. True
b. False

15. AutoPEEP is common in COPD.

a. True
b. False

16. Double triggering in volume control mode may mean that:

a. The patient is not receiving a long enough breath
b. The patient is not getting a deep enough breath
c. The ventilator tubing is leaking
d. a & b

17. Respiratory alkalosis in a patient on mechanical ventilation indicates that the patient:

a. Is in pain
b. Is agitated
c. Has a leaking ventilator circuit
d. Any of the above

18. High peak airway pressure alarms can indicate that:

a. The endotracheal tube is kinked
b. The patient is coughing
c. The patient has developed a pneumothorax
d. None of the above
e. All of the above

19. Who makes the best ventilator simulators?

a. Khaled Fernainy
b. None of the above

20. The patient's nose moves upwards, the endotracheal tube:

a. Moves upwards
b. Moves downwards (is pushed into the patient)
c. Moves sideways

d. Doesn't move.

21. A large and very tired intern leans against a sedated/paralyzed patient on Volume-CMV mode. What alarm is she likely to trigger?:

a. Leak alarm
b. High pressure alarm
c. Disconnect alarm
d. Low exhaled tidal volume alarm.

22. While cleaning up a patient's face, a well meaning caregiver accidentally snips the pilot balloon of an endotracheal tube. What alarm is likely to sound:

a. Leak alarm
b. High pressure alarm
c. Low exhaled tidal volume alarm
d. a & b

23. A ventilator is alarming. When you look at its screen you notice that the patient is getting small tidal volumes followed by a big tidal volume. You have the patient set to get a 400cc tidal volume, but the machine alternates between 10-15cc and 800ccs. What is most likely going on?

a. There is a large leak.
b. The patient is biting the endotracheal tube and preventing the breath.
c. The patient is causing double breaths because of flow dyssynchrony.
d. The ventilator is malfunctioning.

24. Your asthma patient is hypotensive. You've recently increased his respiratory rate because of a blood gas showing mild respiratory acidosis. Things to think about:

a. AutoPEEP
b. Pneumothorax
c. AutoPEEP
d. Again, AutoPEEP

25. The above patient is now very hypotensive. You're still deciding on

whether autoPEEP is a problem. You can:

a. Disconnect the patient from the ventilator, allow him to deflate, and see if he improves.
b. Kick the ventilator and yell "Life is so unfair!"
c. Point to the nurse and scream "What did you do?"
d. All of the above

Answers Chapter 3

1. What curve is this?

Answer: Flow time curve. Notice that it has two directions, the curve above the zero line is the inhalation curve, the curve below, is the exhalation curve.

2. The time it takes to deliver a volume targeted breath:

Answer: d — The time depends on the flow rate and on the inflow pattern. In some ventilators, you can set an I time which will alter the flow rate. All of these parameters can alter the inspiratory time in a volume control breath.

3. A dual target breath is best for:

Answer: c — A dual target breath works best when the patient has a stable breathing pattern and is not air hungry. Of the patient options, only the stable pneumonia patient definitely fits this.

4. A mandatory breath is always triggered by the machine.

Answer: Answer: b — In CMV mode, mandatory breaths can be triggered by the patient.

5. A spontaneous breath is always triggered by the patient.

Answer: a — A spontaneous breath is always triggered by the patient.

6. In a pressure targeted breath, if the patient's lung compliance decreases, what happens to the breath volume?

Answer: b — As lung compliance decreases, the volume of the breath will also decrease in a pressure targeted breath. The ventilator controls the pressure in the circuit and the lung volume depends on how compliant the lung and chest wall are and on whether the patient is actively trying to inhale.

7. In a volume targeted breath, if the patient's lung compliance decreas-

es, what happens to the breath volume?

Answer: c — In contrary to a pressure targeted breath, during a volume targeted breath, the ventilator controls the volume administered and not the pressure. The pressure is variable. When the lung compliance decreases, the pressure rises for the same amount of volume. Unless we hit a pressure that causes the ventilator to cut off the breath (we set this ceiling) the full volume is administered.

8. Continuous Mandatory Ventilation should be use for all except:

Answer: c — While CMV mode can be used for any patient, it isn't a weaning mode. It doesn't give us information about whether a patient will be able to generate their work of breathing, or whether they have a reliable respiratory drive. Of these patients, the one getting assessed for extubation is most likely to benefit from an alternative mode.

9. In Continuous Mandatory Ventilation, breath depth is always constant.

Answer: b — CMV mode is a mode. It can be used to administer breaths of any target. As such, it can be used to administer pressure control breaths that have variable depths or volume control breaths with constant depth.

10. In Intermittent Mandatory Ventilation, the patient's spontaneous breaths are always machine triggered.

Answer: b — In IIMV mode we have a mix of mandatory and spontaneous breaths. The spontaneous breaths are patient triggered.

11. In Spontaneous mode, the ventilator cycles the breath when:

Answer: c — A spontaneous breath is flow cycled. The machine ends the breath when the flow rate reaches a percentage of the peak inspiratory flow (usually 25% but we can alter this on some machines — usually called the expiratory sensitivity). The machine'll also probably end the breath (and yell) if the patient bites the tubing but that's not the answer I was looking for (but you get some points for choosing that).

12. Exhalation time depends on the mechanical breath's inspiration

time.

Answer: a — The time allowed for exhalation depends on the how long inhalation time took. For each breath, the time is divided into exhalation and inhalation time. Less inhalation time means more exhalation time. How long it actually takes to exhale, however, is up to the patient.

13. Time needed for exhalation may change over the course of the patient's illness.

Answer: a — The time needed for exhalation will change over the course of the patient's illness. Bronchospasm, secretions in the trachea and endotracheal tube, and lung compliance all will vary and affect the time needed to exhale.

14. Time needed for exhalation determines how quickly a patient can be ventilated.

Answer: a — The maximum minute ventilation that a patient can tolerate depends on their exhalation time. The more time needed for exhalation, the less the maximal minute ventilation can be. Exceed this, and the patient will breath stack, and eventually autoPEEP will become overwhelming.

15. AutoPEEP is common in COPD.

Answer: a — AutoPEEP is common in COPD, most patients with COPD will have some degree of autoPEEP.

16. Double triggering in volume control mode may mean that:

Answer: d — Flow dyssynchrony means that the patient is not getting a deep enough or long enough breath. The patient continues to inhale causing a mismatch between the ventilator's flow rate and the patiient's flow rate. This may cause a triggered breath during or immediately after another breath — the double (or if particularly naughty, triple) trigger.

17. Respiratory alkalosis in a patient on mechanical ventilation indicates

that the patient:

Answer: d — Respiratory alkalosis means that the patient's CO2 level has dropped and is causing the pH to rise above normal. Basically, the patient's minute ventilation is higher than needed. All of these factors (and more) can cause this.

18. High peak airway pressure alarms can indicate that:

Answer: e — All of these factors will trigger the high peak pressure alarm. A kinked endotracheal tube causes high resistance to the flow of gas (normal plateau). A pneumothorax will fill the chest and restrict lung expansion (hihg plateau pressure). A patient coughing into the ventilator circuit is a common cause of high pressure alarms since gas is suddenly expelled into the circuit and the patient bears down.

19. Who makes the best ventilator simulators?

Answer: Silly question, who's writing these questions? Fire them! Oh…

20. The patient's nose moves upwards, the endotracheal tube:

Answer: a — The endotracheal tube follows the nose.

21. A large and very tired intern leans against a sedated/paralyzed patient on Volume - CMV mode. What alarm is she likely to trigger?:

Answer: b — The increased pressure on the patient's chest and belly will press onto the patient's lungs. The ventilator will need to generate more pressure to reach the prescribed volume (in a volume targeted breath). In a pressure targeted breath, the low exhaled tidal alarm may be triggered since the pressure is fixed and, in response to the external pressure, the ventilator exhales lower volumes.

22. While cleaning up a patient's face, a well meaning caregiver accidentally snips the pilot balloon of an endotracheal tube. What alarm is likely to sound:

Answer: d — Cutting the pilot balloon causes the cuff to deflate. Air will leak around the cuff and escape the patient's lungs without entering the ventilator circuit. The mismatch between the gas administered and the gas returning will trigger the leak alarm, and if big enough, the low exhaled tidal volume alarm.

23. A ventilator is alarming. When you look at its screen you notice that the patient is getting small tidal volumes followed by a big tidal volume. You have the patient set to get a 400cc tidal volume, but the machine alternates between 10-15cc and 800ccs. What is most likely going on?

Answer: c — This sounds like a double breath. The small exhaled volume seen is the ventilator telling you the exhaled volume from the initial breath (which was not exhaled), the second exhaled tidal volume is from the large double inhalation (which is about double the set breath volume).

24. Your asthma patient is hypotensive. You've recently increased his respiratory rate because of a blood gas showing mild respiratory acidosis. Things to think about:

Answer: The point of this question is to emphasize the importance of being aware of autoPEEP in the asthmatic patient. Of course, any of these options is correct.

25. The above patient is now very hypotensive. You're still deciding on whether autoPEEP is a problem. You can:

Answer: a — Disconnecting the ventilator and allowing the patient's chest to decompress would correct the hypotension, if the hypotension was caused by autoPEEP. Never kick ventilator and yelling buys you a visit to the chairman.

Question Chapter 4

1. Supplemental oxygen corrects hypoxemia by:
   a. Correcting VQ mismatch.
   b. Causing vasoconstriction in segments of lung that are not perfused.
   c. Improving oxygenation in low VQ segments of lung.
   d. All of the above.

2. A non-rebreather mask provides:
   a. 100% oxygen
   b. 80% oxygen
   c. 60% oxygen
   d. No-one knows, depends on the patient.

3. Reservoir devices help oxygenation by:
   a. Allowing a higher continuous oxygen flow.
   b. Allowing a burst of oxygen with inspiration.
   c. Improving CO2 removal.
   d. Improving VQ matching.

4. Recruitment of lung tissue:
   a. Turns low VQ segments into normal VQ segments.
   b. Worsens CO2 removal
   c. Worsens shunting of blood through the lungs.
   d. Can only be done with an endotracheal tube.

5. Hypercapnia can be corrected by:
   a. Improving VQ mismatch.
   b. Hyperventilation
   c. Using CO2 depleted gas in the ventilator
   d. A & B
   e. None of the above.

6. Hypercapnia is frequently accompanied by hypoxemia because:
   a. CO2 takes the place of oxygen in the alveolar gas.

b. The hypoventilation that led to hypercapnia has also affected oxygentation.
c. High CO2 causes vasodilation of pulmonary vessels.
d. None of the above.

7. Despite an oxygen fraction of 100% and an appropriate PEEP (per ARDSNet table), a patient remains hypoxic on mechanical ventilation. Your next steps are:

a. Prone positioning
b. Inhalational vasodilators
c. Inverse ratio ventilation
d. All of the above

Answers Chapter 4

1. Supplemental oxygen corrects hypoxemia by:

Answer: c — Supplemental oxygen does not improve VQ mismatch, it actually makes it worse. It helps correct hypoxemia by increasing the oxygenation in low VQ segments but also causes vasodilation which worsens the mismatch.

2. A non-rebreather mask provides:

Answer: d — The percentage of oxygen a non-rebreather mask provides depends on the amount of entrained air pulled by the patient. That can be low or high depending on how air hungry the patient is.

3. Reservoir devices help oxygenation by:

Answer: b — The reservoir holds a volume of oxygen which gets pulled into the patient with the initial high in-flow part of the breath.

4. Recruitment of lung tissue:

Answer: a — Recruitment of lung tissue turns atelectatic low VQ segments into normal VQ segments.

5. Hypercapnia can be corrected by:

Answer: d — Both improving VQ mismatch and hyperventilation will correct hypercapnia. Since CO2 is already a trace gas in air, using air depleted of CO2 won't help much.

6. Hypercapnia is frequently accompanied by hypoxemia because:

Answer: b — CO2 and oxygen use the same gas exchange machinery. A decrease in ventilation will cause a drop in oxygen just as it causes a rise in CO2.

7. Despite an oxygen fraction of 100% and an appropriate PEEP (per ARDSNet table), a patient remains hypoxic on mechanical ventilation.

   Your next steps are:

Answer: d — All these options can improve oxygenation in a patient with intractable hypoxemia.

Question Chapter 5

1. A patient post an Ivor-Lewis procedure is in the ICU, he's developed some respiratory distress and it looks like a COPD exacerbation. He's looks like he's tiring out and will need mechanical ventilation. What's your management?

   a. BiPAP to decrease work of breathing
   b. Incentive spirometery
   c. Endotracheal intubation
   d. Any of the above.

2. A patient in DKA is intubated. The minute ventilation should be set to:

   a. Lower normal range
   b. Normal range
   c. High

3. A hypercapnic asthma patient is intubated. You usually set the minute ventilation to:

   a. Lower than normal
   b. Normal range
   c. Higher range to decrease the CO2.

4. After initiation of positive pressure ventilation a patient's venous return:

   a. Increases
   b. Decreases
   c. Stays the same
   d. Depends on the mode

5. The patient least likely to have a post intubation hypotensive event is the patient with:

   a. Severe pulmonary hypertension
   b. Volume overload and CHF
   c. COPD exacerbation due to emphysema
   d. Severe acidemia due to salicylic acid poisoning

6. Management of post intubation hypotension includes:
   a. Fluids
   b. Vasopressors
   c. Minimizing PEEP
   d. All of the above

7. Causes of increased pulmonary arterial pressures include:
   a. Low lung volumes
   b. High lung volumes
   c. All of the above

8. After intubating a patient with severe pulmonary hypertension:
   a. Get ready to manage severe hypotension.
   b. Take a well deserved break and forget your pager somewhere.

9. After intubation, the function of the left heart is improved because both afterload and preload are reduced. Why is the function the right heart not similarly improved?
   a. The right heart's function is improved but the improvement is not visible because we never check it.
   b. The right heart's function is improved but the rise in pulmonary pressure overcomes that improvement.
   c. The right heart and its circulation are entirely within the chest so pressure changes affect both equally and no improvement can occur.
   d. None of the above

Answers Chapter 5

1. A patient post an Ivor-Lewis procedure is in the ICU, he's developed some respiratory distress and it looks like a COPD exacerbation. He's looks like he's tiring out and will need mechanical ventilation. What's your management?

Answer: c — An Ivor-Lewis procedure is an esophageal surgery. Avoid BiPAP in a patient who's just undergone esophageal surgery. The strain on an anastomosis from positive pressure may tear it. Hint: Whenever you're taking care of a surgical patient, learn about the procedure they've undergone; it'll save the patient and will save you (from an angry surgeon).

2. A patient in DKA is intubated. The minute ventilation should be set to:

Answer: c — A DKA patient is acidemic. A high minute ventilation will be needed to keep the pH closer to normal and avoid a severe acidosis.

3. A hypercapnic asthma patient is intubated. You usually set the minute ventilation to:

Answer: a — Minute ventilation should be set to lower than normal. Focus on a lower respiratory rate and allow a prolonged expiration time.

4. After initiation of positive pressure ventilation a patient's venous return:

Answer: b — After positive pressure ventilation is initiated, the normally negative intrathoracic pressure becomes positive and impedes venous return.

5. The patient least likely to have a post intubation hypotensive event is the patient with:

Answer: b — A volume overloaded CHF patient is less likely to have post-intubation hypotension. The positive pressure helps by decreasing pre-load and can augment cardiac output by decreasing after-load. In severe pulmonary hypertension get your diapers on — the patients can become very unstable after intubation. COPD and

acidemia are also tricky. In COPD, autoPEEP can cause hypotension and make the patients particularly susceptible to the drop in venous return that is expected from mechanical ventilation. Severe acidemia can worsen once mechanical ventilation is initiated if we don't (can't) match the minute ventilation that the patient had before intubation.

6. Management of post intubation hypotension includes:

Answer: d — Management of post intubation hypotension targets the causes. Fluid administration and minimizing PEEP improves venous return. Vasopressors treat the vasoplegia caused by the induction medications and can increase venous tone.

7. Causes of increased pulmonary arterial pressures include:

Answer: c — Both high and low lung volumes increase pulmonary artery resistance and can cause an increase in pulmonary artery pressure.

8. After intubating a patient with severe pulmonary hypertension:

Answer: a — Get ready for a ride! Intubating a patient with severe pulmonary hypertension can precipitate right ventricular failure and profound shock. Be ready to manage this aggressively as discussed in the text.

9. After intubation, the function of the left heart is improved because both afterload and preload are reduced. Why is the function the right heart not similarly improved?

Answer: c — Both the right heart and its entire circulation are within the chest. A rise in intrathoracic pressure is transmitted to both the heart and its circulation. In contrast, the left heart is within the chest and the majority of its circulation is outside. When intrathoracic pressure increases, the left heart is squeezed and its arterial circulation is not. This differential in pressure applied improves the afterload. An opposite effect occurs on the venous side that decreases preload.

Question Chapter 6

1. Mechanically ventilating a patient improves their pulmonary function.
   a. True
   b. False

2. A super-morbidly obese patient's lungs are exposed to higher pressures at the same volume. They are:
   a. More prone to barotrauma
   b. More prone to volu-trauma
   c. Protected from barotrauma
   d. None of the above.

3. The morbidity from mechanical ventilation is limited to damage to the lung and respiratory system.
   a. True
   b. False

4. Extubation is possible when the patient is:
   a. Able to maintain their minute ventilation
   b. Able to oxygenate themselves
   c. Able to protect their airway
   d. All of the above

5. The rapid shallow breathing index is a quantitative measure of:
   a. Fatigue
   b. Minute ventilation
   c. Ability to oxygenate
   d. Muscle strength

6. Pressure support mode is used as a wean trial because:
   a. It allows the patient to determine their own respiratory rate
   b. It allows the patient to determine their own breath depth
   c. It can be set to overcome the resistance of the endotracheal tube
   d. All of the above

7. PEEP improves oxygenation and the more PEEP the more better.

a. True
b. False

8. Increasing PEEP:

a. Decreases atelectasis
b. Increases dead space
c. Either A or B

9. Increasing PEEP:

a. Decreases CO2
b. Increases CO2
c. Either A or B
d. Neither A nor B

10. As you place the patient on low tidal volumes you'll notice an immediate:

a. Improvement in lung compliance
b. Improvement in gas exchange
c. Improvement in patient synchrony
d. None of the above

11. In pregnancy, patients intubation is more difficult because:

a. FRC is lower
b. Airways are more edematous
c. Oxygen usage is higher
d. All of the above

12. A patient suddenly becomes very hypoxic on the mechanical ventilator. The ventilator is alarming loudly. You:

a. Listen to the lungs
b. Pass a suction catheter into the endotracheal tube
c. Call for help
d. Begin to bag the patient.

13. In bronchopleural fistulas, the use of low tidal volume ventilation is contraindicated due to associated patient discomfort:

a. True

b. False

14. A patient on mechanical ventilation and with optimized settings remains hypoxic. The x-ray looks to be clearing up. You decide to look for factors that may be contributing to the hypoxia:

a. Check a CT angiogram looking for pulmonary emboli.
b. Look for shunting with a bubble study.
c. Continue waiting, clinical improvement lags imaging findings.
d. a & b

Answers Chapter 6

1. Mechanically ventilating a patient improves their pulmonary function.

Answer: b False — Mechanically ventilating patients keeps them alive. Once the lungs heal sufficiently or the reason for mechanical ventilation ceases, we extubate the patient.

2. A super-morbidly obese patient's lungs are exposed to higher pressures at the same volume. They are:

Answer: c — The transpulmonary pressure in a super-morbidly obese patient will be lower than a patient of the same height on the same settings. The weight of the belly and chest counter the inflation pressure and so protect the lung.

3. The morbidity from mechanical ventilation is limited to damage to the lung and respiratory system.

Answer: b — Morbidity from mechanical ventilation comes from many other organ systems. Musculoskeletal deconditioning, gastrointestinal ileus…

4. Extubation is possible when the patient is:

Answer: d — All criteria have to be met before a safe extubation can take place.

5. The rapid shallow breathing index is a quantitative measure of:

Answer: a — The RSBI is a quantitative measure of fatigue. A patient fatiguing will breathe with rapid shallow breaths. The RSBI is a quantitative way of describing that pattern.

6. Pressure support mode is used as a wean trial because:

Answer: d All of the above — The pressure support mode, being a spontaneous mode and, therefore, patient triggered and cycled, allows the patient to set the breath duration and rate. The pressure targeted property allows the patient to set the breath depth. These factors let us see what the patient's breathing pattern will be when we

put just enough support to overcome the endotracheal tube.

7. PEEP improves oxygenation and the more PEEP the more better.

Answer: False — More PEEP not more better. PEEP has an optimal level, finding this is part of the skill of mechanical ventilation. A patient can get too much PEEP which can cause increased dead space, hyperinflation, and worsen oxygenation and ventilation.

8. Increasing PEEP:

Answer: c — A restatement of the above question. PEEP may increase dead space if set too high, or decrease atelectasis if set correctly.

9. Increasing PEEP:

Answer: c — Again, re-emphasizing the fact that PEEP can worsen ventilation if set too high. This may be getting boring but it's a concept that is important.

10. As you place the patient on low tidal volumes you'll notice an immediate:

Answer: d — Lung mechanics, blood gases, and patient comfort are worse with low tidal volume ventilation. The benefits are in the long term with decreased lung injury. A large, satisfying breath makes the lungs look clearer on x-ray, makes the patient more synchronous and improves the blood gas. Over the long run, the large satisfying breaths will damage lung and worsen the patients chances at recovery.

11. In pregnancy, patients intubation is more difficult because:

Answer: d — All of the options are correct. The lower FRC and increased oxygen utilization by the baby makes a pregnant patient de-oxygenate faster, the airways are more edematous making visualization and tube placement difficult.

12. A patient suddenly becomes very hypoxic on the mechanical ventilator. The ventilator is alarming loudly. You:

Answer: d — You bag the patient. Patient hypoxia is an emergency and if the ventilator is refusing to ventilate, bag the patient. Bagging al-

lows you to provide oxygen and tells you about ease of bagging — difficult bagging is a sign that there is an issue. The rest should also be done, but bag the patient to keep them alive.

13. In bronchopleural fistulas, the use of low tidal volume ventilation is contraindicated due to associated patient discomfort:

Answer: b — Low tidal volume ventilation can be used in bronchopleural fistulas to minimize the amount of strain on the lung and help minimize the leak.

14. A patient on mechanical ventilation and with optimized settings remains hypoxic. The x-ray looks to be clearing up. You decide to look for factors that may be contributing to the hypoxia:

Answer: d — When hypoxia isn't clearly explained it's reasonable to look for alternative causes. Pulmonary emboli and shunts are possible reasons for persistent hypoxia despite improvement in imaging (which usually lags clinical improvement and not the other way around).